

## Questions on Fourier.

1. What does the fundamental frequency of a musical instrument determine?
2. What is an oscilloscope? What does it do?
3. Explain Fourier synthesis.
4. Explain Fourier analysis.
5. What is a Fourier series?
6. In a nutshell, what is the difference between Fourier analysis and Fourier synthesis?
7. What are harmonics?
8. If the fundamental of a note is 220 Hz, what is the frequency of the second harmonic? Third harmonic?
9. What is a normal mode?
10. Use a graphing calculator (or paste these into the online graphing calculator <http://www.meta-calculator.com/online/>) to graph the following series. What shape do you get for each?
  - a.  $1 \cdot \sin(x) + (1/3) \cdot \sin(3x) + (1/5) \cdot \sin(5x) + (1/7) \cdot \sin(7x) + (1/9) \cdot \sin(9x) + (1/11) \cdot \sin(11x)$
  - b.  $1 \cdot \sin(x) - (1/9) \cdot \sin(3x) + (1/25) \cdot \sin(5x) - (1/49) \cdot \sin(7x) + (1/81) \cdot \sin(9x)$
  - c.  $1 \cdot \sin(x) - (1/2) \cdot \sin(2x) + (1/3) \cdot \sin(3x) - (1/4) \cdot \sin(4x) + (1/5) \cdot \sin(5x) - (1/6) \cdot \sin(6x) + (1/7) \cdot \sin(7x)$
11. For each of the above series, add a few more terms following the pattern and re-plot the series. What can you say about adding more terms to the series?
12. When a trumpet and a clarinet play the same note, they are making a sound wave with the same fundamental frequency. Explain why, even though they are playing the same frequency the two instruments sound different. (Answer with more than just “their timbre is different”.)
13. What is timbre and what causes it?
14. Why do different instruments or voices playing or singing the same note sound different?
15. Suppose you do a Fourier analysis of the sounds from a trumpet and a guitar, each playing the same note. What would be the same in the two analyses and what would be different?
16. Describe your experience with the program Audacity in the mini-lab. What did you do, what did you learn?
17. In general terms, how do electronic synthesizers work?
18. Why does an electric piano sound like a piano?